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From the Lab to the Field: Cooperation among Fishermen

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We conduct a field experiment to measure cooperation among groups of recreational fishermen at a privately owned fishing facility. Group earnings are greater when group members catch fewer fish. Consistent with classical economic theory, though in contrast to prior results from laboratory experiments, we find no cooperation. A series of additional treatments identifies causes of the difference. We rule out the subject pool and the laboratory setting as potential causes and identify the type of activity involved as the source of the lack of cooperation in our field experiment. When cooperation requires reducing fishing effort, individuals are not cooperative.

I. Introduction

A large literature in experimental economics has focused on the extent to which individuals cooperate in social dilemmas. Social dilemmas are group interactions in which an individual maximizes his own payoff

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when he does not cooperate but attaining the social optimum requires cooperation. One experimental paradigm commonly employed to study social dilemmas is the voluntary contribution mechanism (VCM). In a canonical version of this game, each member of a group receives an endowment of money. The members of the group then simultaneously choose to contribute any portion of their endowment to a group account. Contributions to the group account benefit all members of the group. The trade-offs are specified so that each individual has a dominant strategy (assuming selfish preferences) to place his entire endowment in his private account, but the social optimum is attained only if all individuals contribute their entire endowment to the group account. Thus, classical economic theory, which maintains the assumptions of exclusively self-interested motivation and rational decision making, predicts that all individuals allocate their entire endowments to their private accounts.[1] The percentage of endowment placed in the group account can be readily interpreted as a measure of cooperation.

The behavior of individuals who repeatedly play the VCM has been shown to exhibit two robust patterns (for a survey, see Ledyard [1995]). The first pattern is that individuals' initial average contributions to the group account are significantly different from both zero and 100 percent of their endowment. This reveals positive, but less than full, cooperation on the part of the average individual entering a new social dilemma. The second pattern is that a decline in the level of cooperation occurs as the game is repeated (see, e.g., Isaac, McCue, and Plott 1985; Andreoni 1988; Isaac and Walker 1988*b*). The two patterns found in the laboratory are interpreted as evidence that behavior of individuals is systematically different from that of self-interested rational agents. Explaining these patterns has been a focus of a number of models. The positive level of cooperation at the outset of interaction is one of the stylized facts motivating the modeling of other-regarding preferences (Rabin 1993; Fehr and Schmidt 1999; Bolton and Ockenfels 2000; Andreoni and Samuelson 2006), in particular, the inclusion of social welfare in individuals' objective functions (Charness and Rabin 2002). The

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[1] If the game is repeated a finite number of times, the only subgame-perfect equilibrium is for each individual to place his entire endowment in his private account in every period, regardless of the history of play. The social optimum requires all individuals to place their entire endowment in the group account in every period.

decline in cooperation with repetition of the game has been interpreted as a reduction of errors over time (Andreoni 1995; Palfrey and Prisbey 1996; Houser and Kurzban 2002), as reputation building (Andreoni 1988; Sonnemans, Schram, and Offerman 1999; Brandts and Schram 2001), and as a result of a self-serving bias accompanying conditional cooperation (Neugebauer et al. 2009).

In this paper, we consider whether these two patterns appear in a framed field experimental environment. The setting of our field experiment is a privately owned fishing pond where recreational fishermen can catch rainbow trout. We create a social dilemma similar in structure to the VCM. The fishermen are assigned to anonymous groups of four persons, who interact for six 40-minute periods. In each period, each fisherman is allowed to catch a maximum of two fish, which are his to keep. However, for each fish an individual forgoes catching, each of the three other members of the group receives a cash payment. Thus, a social dilemma is created in that each individual has a dominant strategy to catch two fish in each period, while the social optimum requires all individuals to forgo their catches. Cooperation measures are derived from the actual catch of fish, and from the effort made to catch fish, relative to a control treatment in which no collective incentives exist to reduce the catch of fish. Recruitment of subjects takes place 2 weeks in advance of the sessions, so that subjects do not come to the experiment with the expectation that they would necessarily fish for their own benefit and enjoyment as they would on a typical day.

As described in Section II, we find strong support for classical economic theory in our field experiment. There is no evidence of cooperation, even in the initial periods. Beginning in the first period, and continuing throughout the sessions, fishermen in the treatment with group-level gains from cooperation fish with the same effort and catch the same average number of fish as those in the treatment without such potential gains. To explore the source of the difference between our setting and received results from the laboratory, we conduct four additional treatments, which are described and reported in Sections III and IV.

These four treatments establish that the discrepancy in cooperation is not due to the fact that (i) the framing is contextualized in the field experiment, (ii) the subject pool differs, (iii) the field experiment is conducted in a natural rather than in a structured laboratory setting, or (iv) the group benefits and private costs of cooperation are denominated in terms of different units (money and fish) in the field experiment. Rather, the data from these treatments suggest that the key difference between the laboratory and our field setting is the decision variable, the activity that must be undertaken in order to cooperate. When cooperation requires a reduction of fishing, an activity that participants presumably particularly enjoy, individual behavior conforms to classical economic theory, and there is no cooperation. This is independent of whether the reduction in catch results in more money—as is the case in the field experiment described above—or in more fishing opportunities for the group.

Our framed field experiment can be viewed as a test of the robustness of an artifactual field experiment in the sense of Harrison and List (2004). This is the case because we observe members of the same nonstudent pool of subjects in the laboratory, as well as in the field, performing a similar task. We characterize the relationship between our artifactual and framed field experiments as similar rather than identical because by necessity some differences exist in the two implementations. Thus the notion of external validity that is evaluated is whether the behavior in an artifactual field experiment carries over to a closely related framed field experiment. Several other field experiments have documented a positive relationship between individuals' cooperativeness in an experimental VCM game and prosocial behavior in another activity (see, e.g., Cardenas 2004; Henrich et al. 2004; Laury and Taylor 2005; Ruffle and Sosis 2007; Benz and Meier 2008; Carpenter and Seki 2011; Fehr and Leibbrandt 2011). However, there are other studies that do not find such a relationship. For example, Karlan (2005) and List (2006) find that subjects act more cooperatively in laboratory settings than they do outside the laboratory. These latter papers suggest that the laboratory may not always be well suited to test the effectiveness of policy interventions to promote cooperation. Here, we also find that cooperative behavior in an artifactual field experiment does not carry over to a similar field setting, in this case a framed field experiment.[2]

Levitt and List (2007, 2008) have taken the view that social preferences appear with different prominence in the laboratory and in field settings. Our results are consistent with this view. Furthermore, for the particular

[2] Our work bears a relation to a number of other field experiments that focus on cooperation. An active literature is investigating influences on charitable giving (List and Lucking-Reiley 2002; Frey and Meier 2004; Alpizar, Carlsson, and Johansson-Stenman 2008; Croson and Shang 2008; Martin and Randal 2008). Another strand of research uses artifactual field methods to study behavior of nonstudent subject pools in the VCM game (Barr 2001), and a closely related paradigm, the common pool resource game (see, e.g., Cardenas 2003, 2004; Cardenas and Ostrom 2004; Rodriguez-Sickert, Guzmán, and Cardenas 2008). These studies all find positive cooperation in the VCM game among the subject pools studied. The available evidence from framed and natural field experiments is mixed. Erev, Bornstein, and Galili (1993) find considerable evidence of free-riding when students pick oranges under team incentives. When groups act individually, subjects pick 30 percent fewer oranges than when a bonus is given to the group with the highest output. In a one-shot social dilemma setting in a restaurant, Gneezy, Haruvy, and Yafe (2004) find that students choose more expensive meals when the costs are split with five other students than when each pays for her own meal and, thus, exhibit a considerable tendency toward free riding. Bandiera, Barankay, and Rasul (2005) report a substantial degree of cooperation in a fruit-picking firm, but only when the subjects are able to monitor each other.

game we study, we are able to identify several distinct sources of differences in cooperativeness between the laboratory and the field. Our fishermen exhibit more cooperation than student subjects when making decisions in a laboratory environment, fishermen display more cooperation when making decisions in a natural environment than in a laboratory setting, and making the fishing task real rather than virtual reduces cooperation. Nevertheless, the absence of cooperation in our framed field experiment can be attributed only to differences between the real and virtual fishing tasks, since the effects of subject pool and of the structured laboratory setting operate in the opposite direction.

We make no claims that our field experiment is any more generic than the traditional experiment conducted in the laboratory or that commercial fishermen would necessarily behave similarly to recreational fishermen. Rather, we claim only to support the contention that the typical empirical pattern observed in a common laboratory implementation of a social dilemma is not universal and that the behavior of nonstudent subjects in a contextualized laboratory experiment is not necessarily predictive of their behavior in the field.

II. The VCM Experiment in the Field

The first pair of treatments we describe consist of a field implementation of the voluntary contributions mechanism and a control treatment. The treatments, which constitute a framed field experiment in the sense of Harrison and List (2004), are described in subsection A. In subsections B and C we consider methodological issues that arise under our design. We present the analysis of the data in subsection D.

A. The Setting, Game, and Experimental Design

The sessions were conducted at a commercial trout fishing facility called De Biestse Oevers, located in the village of Biest-Houtakker.[3] This village lies in close proximity to Tilburg, in Noord-Brabant province, in the south of the Netherlands. De Biestse Oevers is privately owned and comprises three separate fishing ponds with surface areas of about 12,000 square feet each. One of these ponds served as the venue for our experiment. On a typical day, when no experiment is taking place, a customer can fish for 4 hours for €12.50. The pond has space for 20 fishermen at a time. For each paying customer, four rainbow trout are put into the pond (for an extra fee, salmon trout, a larger variety of trout, can also be thrown in). There are strict rules regarding the fishing gear and type of bait that may be used, but a customer is allowed to catch as many

[3] See http://www.biestse-oevers.nl for pictures of the site.

fish as possible. Also, because of sanitary considerations with respect to the remaining fish, any trout caught cannot be thrown back into the pond and must be taken away from the site (presumably home). Customers therefore have experience with negative externalities since when an individual catches a fish he reduces the number of fish available for others. The typical customer, and hence our typical participant, is Dutch, male, and over 50 years old.

Participants were recruited for our experiment 2 weeks in advance by distributing flyers on site that informed customers of the opportunity to take part in a study conducted by Tilburg University. A maximum of 16 people were allowed to participate in each session.

Two treatments, FieldVCM and FieldPI, were conducted under the following conditions. A session consisted of six consecutive periods of 40 minutes each and therefore took 4 hours to complete. Within a session, each period proceeded under identical rules. Participants were assigned to groups of four, and group membership remained fixed throughout the session. Subjects were not informed at any time of the identity of the other members of their group. At the end of each period, each participant was informed privately of the total number of fish caught by his group.

Before a session began, two rainbow trout per participant were put into the pond plus an additional six trout. For a session with 16 participants, we thus threw in 38 rainbow trout. The number of fish we put into the pond was common knowledge. Before the first period, the participants were randomly assigned a spot at the pond by picking a numbered spot tag out of a bag. This random assignment procedure was repeated before periods 3 and 5. The rotation of positions was intended to create a degree of procedural fairness since many fishermen believe that their physical position at the pond influences their probability of catching a fish.[4]

Each participant was allowed to catch a maximum of two fish per period (rainbow trout or salmon trout, because the latter could still be present because of previous use of the pond). Any fish caught was his to keep, as the standard rules and regulations of De Biestse Oevers prohibit throwing trout back into the pond. At the beginning of each session, we released 38 trout (instead of 32) in an attempt to ensure that, at least in principle, all individuals would be able to catch their quota of two fish each. Once a participant had caught his maximum quota, he was required to wait until the next period began to resume fishing. At the beginning of the next period, a number of trout equal to the total catch of the previous period was put into the water. Therefore, the total

[4] Our data show no actual significant relationship between location and the number of fish caught, suggesting that this belief may be incorrect or exaggerated; see App. A.

number of fish in the pond was the same at the beginning of each period within a given session, and this was explained explicitly to the participants. Communication among subjects was strictly prohibited. A show-up fee of €5 was given at the end of a session.

The above is a complete description of the FieldPI treatment (private incentives, as there are no externalities in this treatment); the FieldVCM treatment differed only in that a social dilemma was created by introducing group incentives for reducing the number of fish caught within each group.[5] Each fish that a participant did not catch below his maximum quota of two per period resulted in a cash payment of €2 to each of the other three group members. Therefore, a participant faced a tradeoff in the FieldVCM treatment between catching a fish for himself and providing a surplus of €6, to be divided equally among the three other members of his group. Note that this game differs from the standard VCM game in that cooperation yields a pure externality; the decision maker does not get any private return to the investments he makes. We imposed this simplification in order to make the social dilemma more obvious to subjects. At the end of each period, participants in the FieldVCM treatment were informed of the group catch in that period, the amount of money they had earned in that period, and their cumulative earnings. The average earnings of a participant in the FieldVCM treatment over the course of a session equaled €40.67. Note that, in contrast to the FieldPI treatment, no show-up fee was given in the FieldVCM treatment.

One round of sessions of the FieldPI and FieldVCM treatments was carried out in June 2008, a second round was conducted in September and October 2008, and a third round was conducted in May 2012. Weather conditions affect the difficulty of catching fish. In June 2008 the water temperature was too high for trout to bite in large numbers, whereas the conditions were much better in October 2008. Therefore, the data from June will be described as having been conducted in the low season and will be designated as the FieldVCML and FieldPIL conditions, while the data gathered in October 2008 will be referred to as FieldVCMH and FieldPIH, with H denoting high season conditions. In May 2012, two extra sessions were conducted, denoted FieldVCMScr and FieldPIScr. The suffix Scr indicates that there was a prior session in which subjects were screened, as described in subsection B.

The data from each of the three pairs of conditions, L, H, and Scr, are analyzed separately. All sessions of the field treatments were conducted

[5] Informing subjects that they are assigned to groups is awkward in a setting in which individual outcomes are completely independent of others' actions. Nevertheless, we wanted to check whether framing the FieldPI treatment as a group exercise has an impact on behavior. Therefore, we conducted one of the FieldPI sessions without informing subjects about any matching procedures. We did not detect any differences in behavior resulting from the different framing.

between 8:00 a.m. and noon (with the instructions starting at about 7:40 a.m.). Paired FieldVCM and FieldPI sessions were always conducted within 1 week of each other.

B. *Establishing the Existence of a Social Dilemma*

In the FieldVCM treatment, a social dilemma exists if the private benefit of the right to catch an extra fish is smaller than the total benefit of the money received by the other three members if that fish is not caught. In other words, a social dilemma exists if participants value the right to catch one additional fish at less than €6. At the session level, a social dilemma exists if the total payoff that we associate with cooperation, €72, is valued more highly than the option to catch two fish in each of six 40-minute periods, the outcome resulting from the behavior that we designate as zero cooperation.

In the FieldVCMScr condition, we ensured that there was a social dilemma. We conducted preliminary sessions in the months before the main session took place. In these sessions, we gave subjects the choice between two options. The first was to fish for 4 hours with a maximum catch quota of two fish in each of six 40-minute periods. Individuals who reached their quotas were required to wait until the current 40-minute period had elapsed before they could fish again. The second option was to receive €72 and to remain at the fishing site for 4 hours. During this period, they could not fish at all. The money was disbursed at the end of the 4 hours. We used a random lottery incentive system to determine if a choice of a fisherman would be implemented. In each session, one-fourth of the fishermen were randomly selected to have their decision implemented. The other three-fourths of the fishermen fished under the normal fishing circumstances at the fishing site: they could fish unconstrained for 4 hours, and four rainbow trout were put into the pond for each fisherman. These rules were explained to all fishermen before they made their choice. As in all of the treatments reported in this paper, individuals were not informed beforehand of what the experiment would entail.

Forty-six fishermen participated in the preliminary sessions. Thirty of the 46 fishermen chose the €72 cash payment over the afternoon of fishing. This establishes that these 30 individuals prefer the payoff resulting from the behavior we interpret as full cooperation to that resulting from zero cooperation. We then recruited all of the 16 participants for the FieldVCMScr treatment exclusively from among these 30 individuals. The session in the FieldVCMScr treatment was conducted 4 weeks after the last preliminary session. Because, as reported in subsection D, the data from FieldVCMScr are very similar with regard to the extent of cooperation to those of the other FieldVCM sessions, we are confident that a social dilemma existed in the other FieldVCM sessions as well.[6]

C. *Measuring Cooperation*

The measurement of cooperation in this setting raises methodological issues that do not usually appear in laboratory experiments. The number of fish caught depends on exogenous factors, such as weather conditions, as well as on the level of cooperativeness. Here, results obtained in the FieldPI treatment serve as the noncooperative benchmark, as FieldPI provides the same incentives to catch the quota of two fish as FieldVCM does if agents are acting noncooperatively.

Comparing catch in FieldPI and FieldVCM during a given condition (L, H, or Scr) provides one measure of cooperation. Cooperation corresponds to a smaller catch of fish in FieldVCM than in FieldPI in the same condition. We call the magnitude of this difference the *catch* measure of cooperation. The level of cooperation in the FieldVCM treatment in the L condition, according to the catch measure, is thus

$$C_j = \frac{1}{G^{\mathrm{PIL}}} \sum_{g=1}^{G^{\mathrm{PIL}}} \sum_{i=1}^{4} x_{it}^{\mathrm{FieldPIL}^g} - \sum_{i} x_{it}^{\mathrm{FieldVCML}^j}, \qquad (1)$$

where x^{it} denotes the number of fish caught by subject i in period t, indices g and j enumerate groups, G^{PIL} and G^{VCML} denote the number of groups in the FieldPIL and FieldVCML treatments, and C_j is our mea-

[6] A payment of €72 would be enough to go fishing for 5 half days at De Biestse Oevers and have €9.50 remaining or, alternatively, to buy 12 fish in a fishmonger's shop (at a price of €4 per trout, the maximum store price we were able to locate) and have €24 remaining. All participants in FieldVCM and FieldPI are regular customers of the fishing facility and live in the vicinity. We also conducted a hypothetical survey of members of our subject pool on a separate date. On a day when no experiments were conducted, 24 fishermen at the site were surveyed. Using the strategy method, we asked each fisherman how many fish he would like to catch, given that he would be charged €0.50 for each fish caught. The fishing facility does not allow throwing back any fish caught, and hence a fisherman's answers reflect the monetary value he assigns to the act of fishing and the value of a fish combined. If a fisherman indicated a nonzero quantity at this price, we asked how much he would like to catch if he would be charged €1 for each fish caught. This procedure was repeated in increments of €0.50 until a fisherman indicated that the fee exceeded his willingness to pay for catching just one fish. The data do not permit us to disentangle the value of fishing and the value of catching fish, but that is not necessary to assess whether a social dilemma exists in our FieldVCM experiment. The results of the survey are as follows. Four fishermen indicated that they would not participate in a scheme in which a fee was charged per fish caught. Therefore, we are not able to derive a maximum willingness to pay for these four fishermen. The remaining 20 fishermen had an average maximum willingness to pay for the first fish they catch of €3.50. One fisherman indicated that he was willing to pay €15 to catch one fish, while another indicated he would pay €6, and the rest indicated a willingness to pay lower than €6. This means that 90 percent of the fishermen had a value of less than €6 for the act of fishing and the first fish they catch. For all of the fishermen, the marginal value of each fish beyond the first was always nonincreasing.

sure of cooperation achieved by group j of the FieldVCML treatment. Analogous measures are defined for the H and Scr conditions. A value of C equal to zero would indicate zero cooperation, and a positive level would indicate the presence of cooperation.

A second measure of cooperation is the number of times an average fisherman casts his fishing rod per minute. There are several advantages of this "input" measure of cooperation. First, casting a rod is a conscious decision of a fisherman. A fisherman can deliberately "work harder" to catch more fish. In Appendix A, we show that there is a significantly positive effect of effort on the number of fish caught. Second, effort yields a less noisy measure of cooperation than catch. Whereas catching zero fish might be a consequence of bad luck, not casting a rod cannot be reasonably interpreted in a manner other than as indicating cooperation. To measure a group's cooperation, we take the average number of casts per minute registered by members of the group in FieldVCM and compare it to the number in FieldPI, pairing the L, H, and Scr conditions. If the average is lower in FieldVCM than in FieldPI, we interpret the difference as an indication that cooperation is observed. We refer to the magnitude of the difference between treatments as the *effort* measure of cooperation. The data on casts per minute were gathered by two experimenters continuously scoring the number of casts of the 16 fishermen at the pond, with each experimenter monitoring eight individuals. This monitoring increases the level of experimenter scrutiny in both FieldVCM and FieldPI—a factor that Levitt and List (2007) have identified as one that fosters prosocial behavior.

D. *Results from the FieldVCM Treatment*

Table 1 illustrates the structure of the field treatments and indicates the amount of data available. Unless noted otherwise, in the analysis of the data we treat the activity of each group of four subjects over an entire session as one observation. This gives us a minimum of four observations per treatment.

The catch of fish and level of effort, as measured by the number of casts per minute, are shown in figures 1 and 2, respectively, for each of the six treatments. In the two figures, the FieldVCM results for the three conditions (H, L, and Scr) are indicated by solid lines and those for FieldPI by dotted lines. Figure 1 shows that the number of fish caught in any of the three FieldVCM sessions is not lower than that in the corresponding FieldPI session. The weather conditions were extremely favorable for fishing on the day that we implemented FieldVCMScr. Despite the fact that participants in FieldVCMScr had revealed, through an incentivized decision, that they prefer the outcome we associate with cooperation (not fish but receive €72) over the one we associate with noncooperation (catching maximally two fish per period), the number

TABLE 1

NUMBER OF GROUPS, MAIN FEATURE, AVERAGE EARNINGS, AND AVERAGE SUM OF INDIVIDUAL CATCH IN THE FIELDVCM TREATMENT AND FIELDPI TREATMENT IN THE HIGH, LOW, AND SCREENED CONDITIONS

Treatment	Groups	Main Feature	Average Earnings	Average Individual Catch
FieldPIH	4	Determine baseline fishing activity in the H condition	€5	6.12
FieldPIL	4	Determine baseline fishing activity in the L condition	€5	1.13
FieldPIScr	4	Determine baseline fishing activity in the Scr condition	€5	2.88
FieldVCMH	4	Difference from FieldPIH measures cooperation in the H condition	€26.63	7.62
FieldVCML	7	Difference from FieldPIL measures cooperation in the L condition	€62.71	1.57
FieldVCMScr	4	Difference from FieldPIL measures cooperation in the Scr condition	€16.13	9.31

NOTE.—A show-up fee of €5 was provided in the FieldPI treatment but not in the FieldVCM treatment.

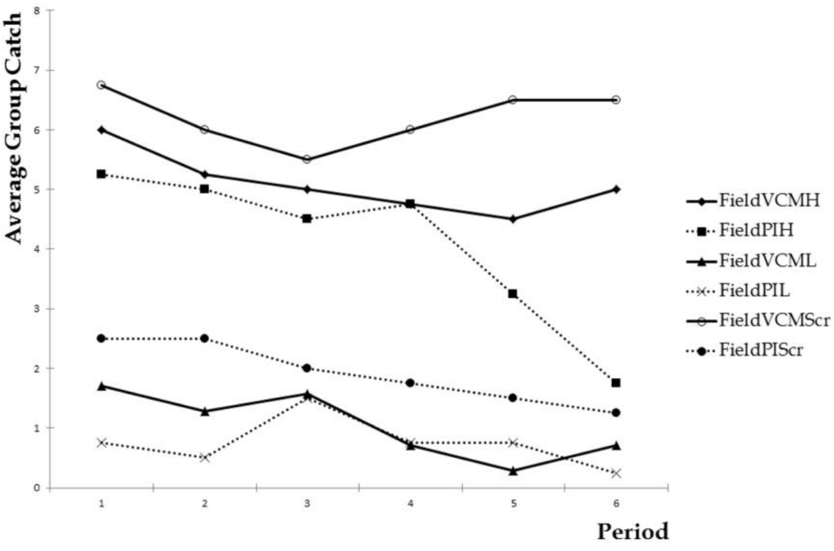

FIG. 1.—Average group catch by period, FieldVCM and FieldPI (L, H, and Scr conditions).

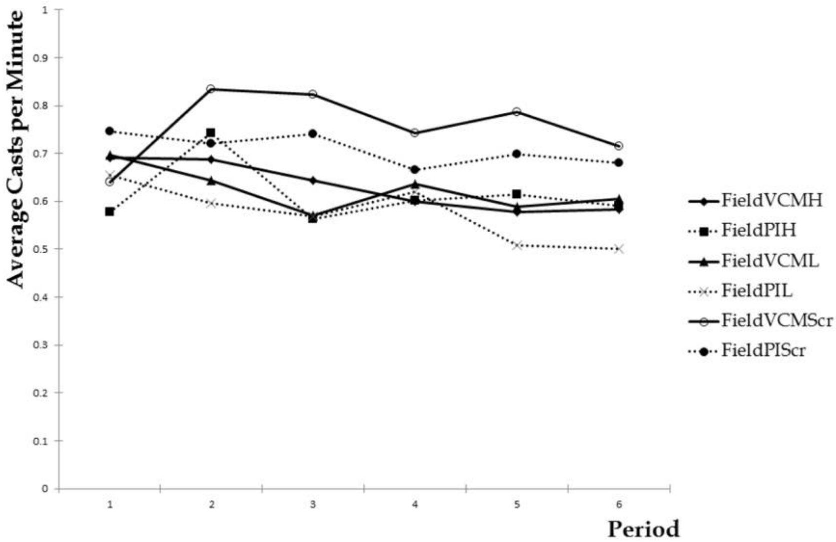

FIG. 2.—Average individual casts per minute by period, FieldVCM and FieldPI (L, H, and Scr conditions).

of fish caught was at least as great as in the FieldVCMH and FieldVCML treatments.[7] Effort follows a similar pattern, as shown in figure 2. In fact, all six treatments yield similar effort levels. On average, the fishermen cast their rod 0.63 times per minute in FieldPI, compared to 0.66 in FieldVCM. Thus, figures 1 and 2 show no evidence of cooperation. The support for result 1 provides the statistical basis for this claim.

RESULT 1. In our social dilemma experiment conducted in the field, FieldVCM, no cooperation is observed.

Support for result 1. We first consider cooperation measured in terms of catch. On average, the catch of fish is actually greater in the FieldVCML, FieldVCMH, and FieldVCMScr treatments than in the corresponding FieldPIL, FieldPIH, and FieldPIScr treatments. A Mann-Whitney test, taking each group's activity over a session as one observation and comparing the catch of fish in the L sessions, fails to reject the null hypothesis of equal catch between the FieldVCML and FieldPIL treatments ($N_1 = 4$, $N_2 = 7$, $p = .14$). In the H sessions, the Mann-Whitney test indicates that more fish are caught in the FieldVCMH treatment than in FieldPIH ($N_1 = 4$, $N_2 = 4$, $p = .06$). In the Scr sessions, we also reject the null hypothesis of equal catch in favor of the hypothesis that

[7] Although higher, the number of fish caught in FieldVCMScr is not significantly different from that in FieldVCMH, according to a standard Mann-Whitney U test ($N_1 = 4$, $N_2 = 4$, $p = .25$).

catch is greater under FieldVCMScr than under FieldPIScr ($N_1 = 4$, $N_2 = 4$, $p = .02$).

Consider now the effort measure. Here, the appropriate Mann-Whitney test indicates no significant differences in casts per minute between FieldVCM and FieldPI, in any of the three conditions: $N_1 = 4$, $N_2 = 7$, $p = .34$ under L; $N_1 = 4$, $N_2 = 4$, $p = .77$ under H; and $N_1 = 4$, $N_2 = 4$, $p = .39$ under Scr. There is no evidence of cooperation by either of our two measures.[8]

Another place to look for evidence of cooperation is to consider the effort levels associated with attempting to catch a second fish, conditional on having caught one fish already in the current period. The quota of catching two fish gives the fishermen the opportunity to cooperate partially by catching one fish, thus enjoying fishing while still earning money for the other members of one's group. Such cooperation would be revealed in lower effort in trying to catch a second fish in FieldVCM than in FieldPI. However, we find no evidence of a difference in effort to catch a second fish between FieldPI and FieldVCM (Mann-Whitney test, $N_1 = 37$, $N_2 = 52$, $p = .84$), taking as the unit of observation the average effort level of each subject over all per-period fishing in all periods in which he caught one fish. QED

We thus find no evidence of cooperation in the FieldVCM treatment. The differences in earnings between conditions in table 1, in particular the considerable earnings in FieldVCML, reflect the relative difficulty of catching fish in the low condition rather than the presence of cooperation. We now consider whether there is a trend in cooperation over time. The visual impression gained from figure 2 is that there is no discernible trend in effort levels. For both catch and effort we test whether the relevant measure of cooperation is different between early and late periods, and the weight of the evidence favors result 2.

Result 2. There is no change in the level of cooperation over time.

Support for result 2. For purposes of this analysis, the *early* periods of a session consist of periods 1 and 2, while periods 5 and 6 are considered the *late* periods. The average group catch and effort over all groups in the first two periods of the FieldPI treatment in a given condition are taken as the zero cooperation baselines for early periods. Similar baselines are constructed for the late periods. Using $k = \{L, H, Scr\}$ to denote the fishing condition, the early baseline is subtracted from group catch in the first two

[8] If a one-sided t-test, which is less conservative in rejecting null hypotheses, is applied, it yields the following results. The difference in catch between the FieldVCM and FieldPI treatments is significant in the low condition ($t = -1.66$, $p = .07$), in the high condition ($t = -3.06$, $p = .01$), and in the Scr condition ($t = -5.88$, $p < .01$). In all cases there are more fish caught in the VCM than in the corresponding PI condition, which is inconsistent with cooperation. As for the effort measure, the differences are not significant in the low ($t = -0.69$, $p = .25$), in the high ($t = -0.30$, $p = .39$), and in the Scr conditions ($t = -0.62$, $p = .28$).

periods for each group in the FieldVCMk treatment separately and the late baseline from group catch in periods 5 and 6 for each group in FieldVCMk. Thus, the difference between each group's catch (effort) in FieldVCMk and the average catch (effort) in FieldPIk is an observation. If the catch (effort) in an observation of FieldVCMk exceeds the average in FieldPIk, we assign the observation a cooperation level of zero. We then test whether cooperation is the same in the early and late periods in either condition, treating each group's catch as a matched pair.

For the catch measure, we find that the difference in cooperation between early and late periods is significant under L (Wilcoxon test, $N_1 = N_2 = 7$, $p = .05$) but with a difference of only 0.10 fish between early and late periods. Under H, we find an insignificant difference ($N_1 = N_2 = 4$, $p = .32$), as well as under Scr ($N_1 = N_2 = 4$, $p = 1$). For the effort measure, we find that the difference in cooperation between early and late periods is insignificant under L (Wilcoxon test, $N_1 = N_2 = 7$, $p = .32$), under H ($N_1 = N_2 = 4$, $p = .58$), and under Scr ($N_1 = N_2 = 4$, $p = .58$).[9] QED

III. Bridging the Gap between the Laboratory and the Field

Section II shows that the pattern of cooperation in FieldVCM is very different from the pattern of behavior observed in conventional VCM experiments conducted in the laboratory. However, the two settings differ in several major aspects, and hence there are a number of candidate causes for the differences in results. These include the subject pool participating, whether the experiment is conducted within or outside the laboratory, and characteristics of the game itself, such as the decision variable (fish or money) and the framing of the task. To isolate the effect of the subject pool and the laboratory setting, we conduct three treatments, called StuLab, FisherLab, and FisherPond. We will refer to these collectively as the *lab* treatments because of their relatively close adherence to traditional laboratory experimental procedures.

In subsection A we describe the procedures that are common to the three treatments. Subsection B describes differences between the three treatments. The results are presented in subsection C.

A. *The Laboratory Version of Our Social Dilemma Game*

As in the FieldVCM treatment, participants in the three lab treatments were assigned to groups of four subjects. Each group's composition remained constant throughout its six-period session. Sessions were conducted by hand using pen and paper. Participants were asked to decide

[9] When a t-test is used, the difference is also insignificant at conventional levels in all conditions.

how many virtual fish to catch in each period, with a maximum of two fish per period. Each fish that a participant decided to catch yielded her a real cash payment of €1; each fish that the participant did not catch yielded €0.50 to each of the other three group members. The earnings of an individual are given as follows:

$$\pi_{it} = €1 \times x_{it} + €0.50 \sum_{j \neq i} (2 - x_{jt}), \quad (2)$$

where π_{it} are the earnings in euros of subject i in period t, and $x_{it} \in \{0, 1, 2\}$ is the catch of subject i in period t. There is a dominant strategy to catch two virtual fish, yielding individual payoffs of €2 per period. The social optimum, with each group member receiving €3 per period, can be reached only if all players choose to catch zero fish. The duration of a session of the lab treatments takes about one-fourth of the duration of a session of the field treatment. Therefore, earnings in the lab treatments are scaled down by a factor of 4 to make the earnings comparable to those in the field treatments.

In contrast to the traditional laboratory experiment, the language of the instructions was contextualized to approximate a virtual implementation of the FieldVCM treatment. For example, the terms “fish,” “catch,” and “pond” were used rather than terms such as “tokens,” “account,” and “project.” After the instructions were read out loud, the participants had to answer some test questions, which they answered without much difficulty.

After each period the experimenter informed all participants about the decisions of every subject in the session. This was done by posting the catch decisions of all participants, next to their identification numbers, for all participants to see on a whiteboard in front of the room. This meant that each subject was able to monitor and track every other individual subject’s decisions over time. However, none of the subjects were informed about which of the other session participants were in his own group, and there were either 12 or 16 subjects in each session. This approximated the content and precision of the information available to participants in the FieldVCM and FieldPI treatments, in which individuals could observe others but did not know who was in their group. After each period, subjects were informed, in private, of their earnings in that period as well as of the sum of the total group catch. All communication between participants was strictly forbidden, a rule that was well respected in all sessions.

B. *Constructing the Bridge from the Laboratory to the Field*

The first experiment, StuLab, was a conventional lab experiment conducted with student participants in the Center for Economic Research laboratory at Tilburg University. We specifically and exclusively invited students with a Dutch nationality to participate. This restriction was intended to control for cultural factors, which could potentially influence the results (see, e.g., Brandts, Saijo, and Schram 2004; Hermann, Thöni, and Gächter 2008). In total, 32 students participated in the StuLab experiment, yielding eight groups of four subjects. All of the students were economics, law, or psychology majors. On average, the participants in this treatment earned €12.98 in the experiment.

The second lab experiment, FisherLab, was identical to the StuLab experiment except for the subject population, who were customers of De Biestse Oevers, the same subject pool sampled for the FieldVCM and FieldPI treatments. Thus, FisherLab can be classified as an artifactual field experiment according to the definitions of Harrison and List (2004). The experiment was conducted in the restaurant of De Biestse Oevers, which was temporarily transformed into an experimental lab. We rearranged the restaurant so that it closely resembled a standard experimental laboratory. We brought folding tables (normally used as exam tables for students taking large-scale written examinations at Tilburg University) and placed them in rows well apart from each other. This ensured that subjects could not read their neighbors' decision sheets. We installed a blackboard in front of the rows of tables, on which we recorded their virtual catch decisions. We applied the procedures customary to sessions conducted in our laboratory. In total, 32 fishermen participated in this experiment, comprising eight groups of four participants, and thus yielding eight independent observations. On average, the participants in this experiment earned €13.65.

The third experiment, FisherPond, was identical to the FisherLab experiment except that the FisherPond experiment was conducted while participants were actually fishing at the pond. They performed the experimental task (i.e., deciding how many virtual fish they wanted to catch in each of the six periods) in their original fishing location, and their fishing was only briefly interrupted as they listened to the instructions and indicated their decisions to the experimenter from time to time. The physical environment in which the experiment took place was thus the same in FisherPond and in FieldVCM, but the catch decisions pertained to virtual fish in the former treatment and to real fish in the latter treatment.

Recruitment took place by approaching fishermen at the pond and asking them if they would be willing to participate in a research study conducted by Tilburg University. We deliberately approached fishermen located at some distance from other participants in order to exclude the possibility of participants contacting each other, and they were to remain in their original locations during the experimental task. Once we had recruited all participants for a session, the rules were explained to all of them simultaneously at a central location. This was intended to ensure common knowledge of comprehension of the task among all participants. Participants were given a typed summary of the instructions and listened to the experimenter reading aloud the full version of the instructions. As in all other treatments, we used partner matching throughout each session, but individuals were never informed about the identity of the other members of their group.

After the instructions, the fishermen returned to their prior fishing spots and resumed fishing. An experimenter circulated among the subjects collecting their virtual catch decisions and providing information about others' virtual fishing decisions and outcomes, while the participants continued fishing. As in StuLab and FisherLab, participants were informed privately, after each period, of the virtual catch decisions of all other subjects in the session and their own earnings. They were also notified, in private, about their earnings and about the sum of fish caught by the three other members of their own group as in all other treatments.

After period 6 was completed, each participant was paid his earnings and then continued fishing for the remainder of the morning. The average earnings for the participants in this experiment were €14.30. Table 2 summarizes the number of groups, main features, and average individual earnings in the StuLab, FisherLab, and FisherPond experiments.

C. *Results in the StuLab, FisherLab, and FisherPond Experiments*

Figure 3 shows the average levels of cooperation over time in the three lab experiments, StuLab, FisherLab, and FisherPond. Cooperation is measured as the average number of virtual fish not caught per group. That is, the level of cooperation is the maximum possible group catch in a period, eight, minus the actual, albeit virtual, catch. The figure shows that, as in prior controlled laboratory studies, the level of cooperation among student subjects is positive in the early periods of the game and decreases as the game progresses. We obtain the following result.

TABLE 2
Number of Groups, Main Feature, and Average Individual Earnings in the (Virtual Fishing) Lab Experiments.

Experiment	Groups	Main Feature: Isolate Effects of	Average Earnings
Students in the lab (StuLab)	8	Contextualization	€12.98
Fishermen in the lab (FisherLab)	8	Fishermen subject pool	€13.65
Fishermen at the pond (FisherPond)	7	Laboratory setting	€14.30

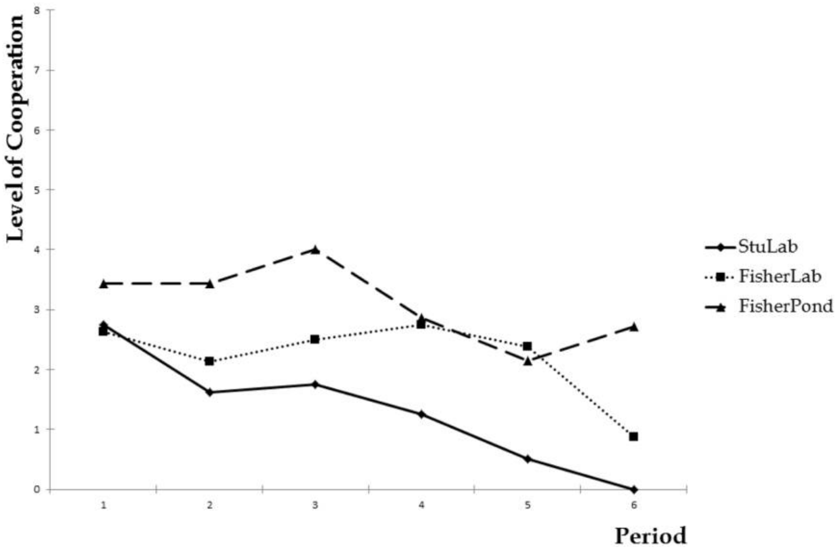

FIG. 3.—Levels of cooperation (maximum possible group catch minus actual catch) in the lab experiments by period, averaged over all groups.

RESULT 3. Cooperation patterns in the StuLab experiment conform to the usual patterns observed in the VCM game as typically implemented in the laboratory. The lack of cooperation in FieldVCM is therefore not due to the contextualization of the decision.

Support for result 3. Figure 3 shows that in early periods of the StuLab experiments, students cooperate in the first period, but increasingly less so in the later periods. A *t*-test shows that in the StuLab experiment, the cooperation level is significantly different from zero in period 1 ($N = 32$, $p < .01$). In this test, the choice of an individual, rather than a group's average contribution, is taken as an independent observation (because in the first period, there are no intragroup dependencies resulting from the history of play). A Wilcoxon test comparing "early" and "late" play, taking the group average contribution over periods 1 and 2 as an observation of early play and the group average over periods 5 and 6 as an observation of late play, yields a *p*-value equal to .01 ($N_1 = N_2 = 8$) for the StuLab experiment. Hence, cooperation decreases significantly over time. QED

Thus, we find that the lack of cooperation in the first periods of the field experiments is not a result of contextualization. Next, we test whether the lack of cooperation found in FieldVCM is due to differences in the subject pool. It may be the case that fishermen are systematically less cooperative than students and that such a difference accounts for the behavior we observe in the field treatments. However, when comparing play in the StuLab and the FisherLab experiments—which are identical except for the characteristics of the subjects that participate—we find that, if anything, recreational fishermen are more cooperative than students. This is reported as result 4.

Result 4. Cooperation is greater in FisherLab than in StuLab. The lack of cooperation in FieldVCM is therefore not due to recreational fishermen being intrinsically less cooperative than students.

Support for result 4. Figure 3 shows that students exhibit a lower level of cooperation than the fishermen in the laboratory. This is supported by a Mann-Whitney test ($N_1 = 8$, $N_2 = 8$, $p = .02$) as well as a t-test ($t = 2.87$, $p = .01$) that reject the hypothesis of equal cooperation.[10] QED

Thus, the behavior of recreational fishermen in the laboratory experiment is not predictive of their behavior in the field experiment. One may argue that this is not unexpected because recreational fishermen are likely to have competitive instincts—they will try to catch more fish than their peers—and hence it is not surprising that we find no evidence of cooperation in the field. On the other hand, it is striking that fishermen act cooperatively, even more so than students, in a contextualized laboratory experiment. A necessary condition for laboratory experiments to be reliable tests of policy interventions is that people bring their true preferences into the laboratory; comparison of the results of FisherLab and FieldVCM suggests that this is not always the case.[11]

Furthermore, the above shows that subject pool composition alone does not account for the lack of cooperation in FieldVCM: both students and fishermen display positive levels of cooperation in the lab. We now consider whether the laboratory setting itself has an effect on the cooperation levels that the fishermen exhibit. We do so by comparing behavior in the FisherLab and FisherPond experiments. These two experiments are identical except that one is conducted in a synthetic environment very similar to an experimental laboratory whereas the other is conducted in more natural conditions, administered while subjects are engaged in another activity. From this comparison, we obtain result 5.

[10] Initial cooperation is also significantly different from zero for the FisherLab experiment. The Student t-test shows that individual cooperation levels are significantly different from zero in period 1 in the FisherLab experiment ($N = 32$, $p < .01$). In this experiment, average group cooperation decreases over time, but not significantly. A Wilcoxon test comparing the group average of periods 1 and 2 to that of periods 5 and 6 yields a p-value of .23 ($N_1 = N_2 = 8$).

[11] There is some evidence that high-sea professional fishermen, a distinct group from recreational fishermen, are particularly competitive. Two quotes illustrate this point. Analyzing the catch decisions of Norwegian fishermen targeting blue whiting, Gezelius (2007) quotes a skipper stating that "[the choice of technology is not so much] a question of cost, but of fishing more than your neighbor." For a detailed analysis of the competitive spirits of high-sea fishermen, see van Ginkel (2009, 221–28).

RESULT 5. Cooperation in the FisherPond experiment is greater than in the FisherLab experiment. Cooperation is reduced by the laboratory setting.

Support for result 5. Figure 3 shows that the average level of cooperation in the FisherPond experiment is higher than in FisherLab. A Mann-Whitney test shows that this difference is statistically significant ($N_1 = 8$, $N_2 = 7$, $p = .04$), as does a t-test ($t = 2.43$, $p = .03$).[12] QED

This result suggests that the formally structured laboratory setting itself reduces cooperative behavior, at least for our subject pool of recreational fishermen. Therefore, the fact that our experiment is conducted outside of the laboratory cannot, on its own, account for the lack of cooperation we have observed in FieldVCM. The difference between FisherLab and FisherPond indicates that environmental cues can influence the extent to which social preferences are reflected in behavior.

IV. Is It the Activity or the Presence of Multiple Reward Media?

The experiments reported in Section III show that the difference between our field experimental results and traditional laboratory results persists when the effects of subject pool and the laboratory are removed. The source of the discrepancy in results must lie in differences between our field and the traditional laboratory implementations of the VCM. While there are several substantive differences, we believe that the most salient is the decision variable that must be modified in order to cooperate. In FieldVCM, players cooperate by fishing less, whereas in the three experiments described in Section III, they cooperate by giving up money.

There are two separate mechanisms whereby the decision variable could affect the level of cooperation. The first is the possibility that the decision variable itself influences cooperation. It may be that if a reduction in fishing is required to achieve cooperation, individuals are less cooperative. The second is that when group benefits and private costs of cooperation are measured in different units, as in the FieldVCM treatment (money vs. fish not caught rather than the money vs. money trade-off in the lab experiment), individuals are less cooperative. Different units of account might introduce self-serving biases in beliefs about the trade-offs between the two units. For example, individuals may convince themselves that other players prefer to fish rather than to have money and, thus, that failure to reduce one's own fishing is compatible with attaining the social optimum.

[12] As in the other lab experiments, cooperation in the first round is also significantly different from zero for the FisherPond experiment, as indicated by a standard t-test, taking each individual catch decision as an independent observation ($N = 28$, $p < .01$). In this experiment there is also a significant decrease of cooperation over time. A Wilcoxon test comparing the group average cooperation of periods 1 and 2 to that of periods 5 and 6 yields a p-value of .02 ($N_1 = N_2 = 7$).

To investigate whether the decision variable is the key factor influencing behavior and to distinguish between two possibilities given above of the manner in which it influences behavior, we construct an additional framed field experiment, which we call FieldFT. Here, FT denotes fishing time, the only reward medium present in this treatment.

A session of the FieldFT treatment consists of two parts, which take place consecutively within the same session. Part 1 consists of three periods of 30 minutes each, during which each participant is allowed to catch at most two fish per period. Part 2 lasts for at most 150 minutes, during which each participant is allowed to catch as many fish as he can, receiving a financial bonus for each. However, the actual duration of part 2 for each individual participant depends on how many fish each of the three other members of his group caught in part 1.

At the beginning of part 1, two rainbow trout per participant, plus an additional six trout, are put into the pond. In each session, 16 fishermen participated, and hence we always threw in 38 fish at the start of a session. The spot at which a participant fishes is assigned by a lottery. In each of the three 30-minute periods, each fisherman is allowed to catch up to two fish. After he catches a second fish within a period, the fisherman has to stop fishing and wait until the start of the next period. The fisherman is allowed to keep all fish he catches, and he does not receive any monetary payment in part 1. At the end of each period within part 1, each fisherman is informed of the number of fish caught by each of the other members of his group in the period. As was the case in the FieldVCM and FieldPI treatments, the stock is replenished in every period by throwing in the same number of fish that were caught in the previous period. That means that the difficulty of catching a fish is roughly the same in each period within part 1.

In part 2, participants are free to catch as many fish as they would like. In addition to being allowed to keep the fish, individuals receive a bonus of €2 for each fish that they catch. We keep the level of difficulty of catching fish roughly constant within part 2 by replenishing the stock of fish every 30 minutes, throwing in the same number of fish that were caught in the preceding 30 minutes. Fishing in part 2 is thus more attractive than fishing in part 1. Part 2 lasts longer (150 minutes rather than 90 minutes in part 1), there is no constraint on the number of fish one is allowed to catch (as opposed to maximally two fish per half hour), and one receives €2 for every fish caught (as opposed to receiving no monetary reward).

The social dilemma is introduced by the imposition of the following rule. Each fish that a fisherman catches in part 1 reduces the length of time that each of the other three members of his group can fish in part 2, by 10 minutes. Assuming that a fisherman has monotonically increasing preferences over fish, fishing time, and money, fishing in part 2 is more valuable than in part 1. Prior to the FieldFT sessions, we administered questionnaires with 21 fishermen. In the questionnaire, we asked fishermen about their indifference point between catching six fish in 90 minutes and waiting 90 minutes and then fishing unconstrained for 150 minutes, earning €x per fish caught. As can be seen in Appendix B, 14 of the 21 would prefer waiting 90 minutes in order to be able to fish unconstrained for 150 minutes thereafter even if there is no monetary reward for catching fish in part 2; only two fishermen indicated that they need to receive more than €2 per fish caught in part 2 to prefer participating in part 2 than in part 1. Therefore, we are confident that our parameterization induces a social dilemma.

The social optimum is attained if all group members catch no fish in part 1. However, the subgame-perfect Nash equilibrium strategy for each fisherman is to fish at full force in each period of part 1, since only other group members are harmed if an individual catches a fish. If all participants catch their maximum allowable quantity of two fish per period in each of the three periods of part 1, each participant's available fishing time in part 2 is reduced from 150 to 0 minutes.[13] The sessions were conducted in April and May of 2010, and 12 groups of four subjects participated in this treatment.

We compare catch and effort between parts 1 and 2 of the experiment. In part 2, there are no negative externalities and there is even an additional incentive to try to catch more fish (the individual bonus of €2 per fish caught). Thus, part 2 catch and effort correspond to the level of activity that would exist if there was no cooperation. However, when comparing effort in part 2 to that in part 1, we actually find that effort is greater in part 1; see also figure 4. A similar result is obtained if period 3 is tested against part 2.

Result 6. In the FieldFT treatment, there is no evidence of cooperation. Average effort in part 1 is greater than that in part 2. The lack of cooperation in FieldVCM is not due to the existence of different reward media for selfish and cooperative behavior.

Support for result 6. We use a Wilcoxon matched pairs test, taking the average effort level of a group in part 2 and either the average effort level of that group over all three periods in part 1 or the average effort level of that group in just the third period of part 1 as an independent pair. Effort levels in part 1 are greater than in part 2 ($N_1 = N_2 = 12$, $p < .01$) if all of part 1 is considered, as well as greater in period 3 of part 1 than in part 2 ($N_1 = N_2 = 12$, $p < .01$).

Furthermore, there is no evidence of partial cooperation. The effort levels associated with trying to catch one's first fish are not significantly

[13] Because of the nonnegativity constraint, a participant's fishing time in part 2 is set to zero if the other three participants in his group catch, in total, more than 15 fish in part 1.

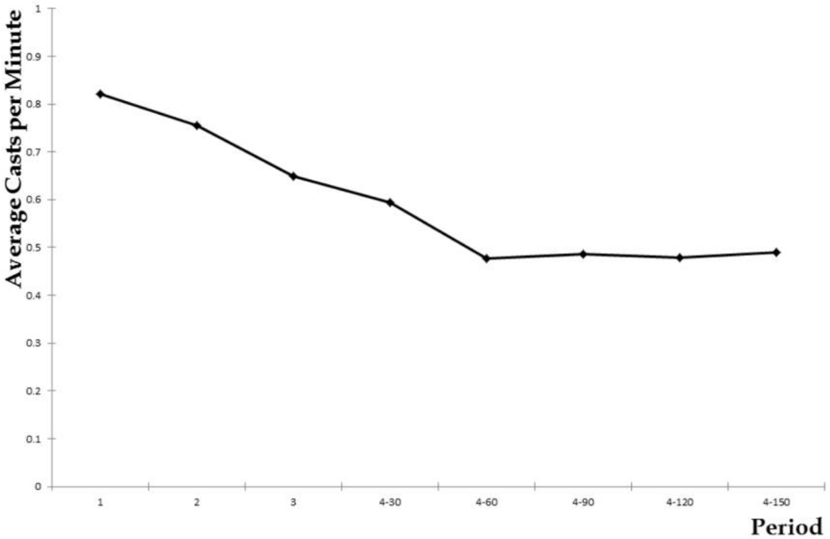

FIG. 4.—Average individual casts per minute by period, FieldFT. On the horizontal axis, the numbers 1–3 denote the periods of part 1, while the average effort levels in part 2 (or period 4) are presented at 30-minute intervals.

different from those for the second fish in period 1 ($N_1 = N_2 = 24$, $p = .71$), in period 2 ($N_1 = N_2 = 15$, $p = .18$), or in period 3 ($N_1 = N_2 = 9$, $p = .34$). QED

As was the case in FieldVCM, and in contrast to FisherLab and FisherPond, we do not detect any cooperation in FieldFT.

V. Conclusion

The data from our framed field experiment are consistent with the predictions of classical game theory. We find no evidence of cooperative behavior. We detect no difference in behavior between a situation in which refraining from fishing yields a large positive externality to the group (the FieldVCM treatment) and when it does not (the FieldPI treatment). Indeed, if anything, there is some evidence that the social dilemma triggers negative cooperation. This conclusion contrasts sharply with results from studies of the VCM game when it is implemented in the laboratory. In such laboratory settings, cooperation is typically positive at the outset of a group's interaction and declines over time. While the behavior of recreational fishermen may not be of special economic interest in itself, it is striking to see the difference in their behavior in the field compared to a contextualized laboratory environment.

Additional treatments allow us to explore potential causes of the difference between the results we have observed and those from previous laboratory studies. The treatments permit us to rule out four would-be explanations: (i) differences in contextualization between the game we implemented in the field and the standard VCM implemented in the laboratory, (ii) differences in the subject pool (students vs. recreational fishermen), (iii) differences between the settings in which the experiments are conducted (the laboratory vs. a more natural environment, the recreational fishing pond), and (iv) differences in the units in which the benefits and costs of cooperation are measured (money vs. money or money vs. fish).

When implementing our modified version of the VCM game in the laboratory using student subjects, we find a pattern of behavior very similar to that typically observed in standard VCM lab experiments. In addition, we find that using students as participants lowers cooperation compared to our subject pool of recreational fishermen. This result is consistent with those obtained by Charness and Villeval (2009), who observe that students cooperate less than senior citizens in a laboratory VCM game presented in neutral decontextualized terms. Therefore, the use of students alone cannot account for the greater cooperation observed in received laboratory experiments than in FieldVCM. Conducting the experiments in the structured and formal setting of an experimental laboratory decreases cooperation among our subjects. They are more cooperative when participating in a voluntary contributions game while they are fishing than when they are in the laboratory. Therefore, the fact that the experiment is conducted outside the laboratory cannot on its own account for the lack of cooperation.

The most plausible remaining explanation for the difference between our laboratory and field experiments is the nature of the decision variable. Our subjects are unwilling to forgo fishing to yield benefits to the group, even when group benefits are also in terms of fishing (as evidenced by FieldFT). Nevertheless, subjects from the same pool are willing to cooperate if it involves sacrificing own monetary earnings for the benefit of the group. Taken together, our data are consistent with the assertion that cooperativeness depends on the decision variable, the activity that must be modified in order to yield a benefit to the group. This statement is not to deny the importance of other factors; for example, whether similar results would apply to professional high-sea fishermen is an open question.

Some readers of this paper have suggested that a demand effect may exist in the experiment in that "fishermen participate in the experiment to fish" and that when individuals find themselves at the fishing pond, the desire to fish overwhelms the money that we offer the group not to fish. However, we note that a similar effect exists with students who participate in traditional laboratory experiments: students presumably participate in such experiments with the primary motivation of earning money for themselves. While fishermen might be disposed to feel that the pond is a place to fish, subjects in the laboratory presumably are primarily disposed to view it as a place to earn money for themselves, in equal measure. While some students also come to the laboratory to learn some economics, some fishermen also have similar motives to learn from others to improve their fishing technique. Social preferences, such as the motive to increase social efficiency, have been shown to exist in student subjects; there is no reason to suppose ex ante that such motives would not be present among the fishermen. Indeed, the FisherLab and FisherPond treatments show that these motives are at least as strong among the fishermen as the students when such motives are measured with the same game. Furthermore, in the FieldFT treatment, payoffs are entirely in terms of fishing. Reducing one's own fishing increases the overall fishing opportunities available to the group. Thus, the trade-off is fully in terms of the reward medium that is typically associated with the venue. As described earlier, we find no cooperation in FieldFT, in agreement with standard economic theory, indicating that a demand effect of the type described above could not account for the lack of cooperation that we observe.

It has been shown in some field experiments that decentralized cooperation can be successful (see, e.g., Erev et al. 1993; Bandiera et al. 2005). Cooperation can be found in naturally occurring social dilemma situations as well (see, e.g., Ostrom 1990). However, our results suggest that this successful cooperation does not spontaneously arise. When there is no contact possible between agents facing a social dilemma, the mere presence of potential group-level gains resulting from the sacrifice of private payoffs does not guarantee cooperation—even if the group concerned is small in number. The propensity to cooperate appears to depend on the nature of the activity that individuals must undertake, or refrain from, in order to increase group payoffs.[14]

It may be the case that to reliably achieve cooperation in a setting such as ours, some additional structure is required. This structure might be an effective avenue of communication between individuals (Isaac and Walker

[14] Results that are similar in spirit, i.e., showing that the extent to which social preferences appear depends on the decision variable, are reported in Fershtman, Gneezy, and List (2008). They consider a dictator and a modified trust game. In one set of treatments, individuals allocate a pool of money within a traditional laboratory implementation of these two games (see, e.g., Forsythe et al. 1994; Berg, Dickhaut, and McCabe 1995). In another set, individuals earn a greater share of the money to be divided with better performance in a real effort task, in essence framing the game as a competition over resources. The results show that players do indeed behave more competitively in the real effort task condition. The authors offer the interpretation that the presence of different norms in the two situations accounts for the difference in the influence of social preferences on decisions.

1988*a*), a system of punishment of noncooperators (Fehr and Gächter 2000), or a mechanism for increasing and maintaining social pressure (Gächter and Fehr 1999; Masclet et al. 2003) or strengthening group identity (Eckel and Grossman 2005; Charness, Rigotti, and Rustichini 2007; Chen and Li 2009). All of these factors have been found to increase the level and sustainability of cooperation in laboratory social dilemmas. It is thus reasonable to conjecture that the presence of one or more of these instruments may be necessary, or at least make it more likely, to achieve cooperation in some inhospitable field settings, such as the one we have studied here. It may also be the case that if the trade-off between individual incentives and group payoffs were altered so that it became less costly to cooperate, perhaps by increasing the €2 externality to others from not catching a fish to a much larger amount, then some cooperation would arise. On the other hand, cooperation may be so difficult to achieve in our setting that even the introduction of the instruments just described or changing the incentives to cooperate may not be effective.

Appendix A

Statistical Analysis of the Effect of Effort on Catch

This appendix shows that the number of casts per minute, our effort measure of cooperation, is correlated with the number of fish caught, which is used to calculate our catch measure of cooperation. Thus, we establish that effort is a legitimate measure of cooperation: a higher casting frequency increases expected private payoff and decreases expected group payoff.

An ordered probit model is used to estimate the effects of fishing effort on the number of fish caught, as presented in table A1. The dependent variable is an individual's catch of fish in a period. The table contains estimates of the pooled data from the FieldVCM and FieldPI treatments (in all three conditions H, L, and Scr).

TABLE A1
Relationship between Individual Effort and Individual Catch
Dependent Variable: Number of Fish Caught in a Period

Variable	Estimate
Effort	.742***
	(.277)
I(H Condition)	1.451***
	(.123)
I(Scr Condition)	1.207***
	(.180)
Quadrant fixed effects	Yes
Observations	648
Pseudo-R^2	.1465

Note.—Standard errors, clustered at the subject level, are reported in parentheses.
*** Significant at the 1 percent level.

The model shows a clear positive and significant effect of our measure of effort, casts per minute, on the catch of fish. The variables *I*(High Condition) and *I*(Scr Condition) have a value of one when an observation is taken from the corresponding condition. The quadrant fixed effects are dummy variables that capture the position at the pond at which a fisherman is fishing. The quadrant dummy variables are insignificant, indicating that the position at which an individual fishes has no influence on his catch of fish.

Appendix B

Survey about the Value of Fishing in FieldFT

In this appendix we present the questionnaire that we used in the FieldFT treatment to determine whether a social dilemma existed and the responses we obtained.

The Questionnaire

Dear fisherman,

On behalf of Tilburg University we would like your cooperation in filling out a questionnaire. We ask you to indicate which of the following two options is your preferred option.

Option 1	Option 2
Fish for 1.5 hours and catch at most 6 fish	Wait for 1.5 hours at your fishing spot and then fish as much as you want for 2.5 hours
Fish for 1.5 hours and catch at most 6 fish	Wait for 1.5 hours at your fishing spot and then fish as much as you want for 2.5 hours, receiving €0.50 for each fish caught
Fish for 1.5 hours and catch at most 6 fish	Wait for 1.5 hours at your fishing spot and then fish as much as you want f or 2.5 hours, receiving €1 for each fish caught
. . .	. . .
. . .	. . .
Fish for 1.5 hours and catch at most 6 fish	Wait for 1.5 hours at your fishing spot and then fish as much as you want for 2.5 hours, receiving €15 for each fish caught

Results of the Questionnaire

A social optimum of no fishing in periods 1–3 is induced if fishermen prefer to wait for 1.5 hours in order to fish on an unlimited basis for 2.5 hours while receiving €2 per fish caught. Table B1 shows the results of the questionnaire. In total, we have surveyed 21 fishermen.

Table B1 shows that 19 out of 21 fishermen claimed to be better off waiting for 1.5 hours and then fishing on an unconstrained basis for 2.5 hours and being paid €2 for each fish caught. We are therefore confident that our experimental parameterization induced the social dilemma we sought to create.

TABLE B1
Results of the Survey

	Willingness to Accept to Choose Option 2				
	€0	€0.50	€1	€1.50	> €2
Number of fishermen	14	3	1	1	2

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